Claims

[c1] 1. A system for analyzing the stresses in a structure, comprising:

a laser module including a laser light source to produce a light beam;

a plurality of sensor modules each including a fiber Bragg grating;

a plurality of filter modules paired with said sensor modules, wherein each said filter module includes a filter device and a photodetector to produce a detector signal;

a first set of optical fiber to communicate portions of said light beam from said laser module to said plurality of sensor modules;

a second set of optical fiber to communicate portions of said light beam from said sensor modules to respective said filter modules; and

a monitoring station to receive said detector signals and perform analysis thereon.

[c2] 2. The system of claim 1, wherein said laser module additionally includes at least one member of the set consisting of frequency locking sub-systems and intensity

stabilization sub-systems.

[c3] 3. The system of claim 2, wherein said a said frequency locking sub-system is provided and includes multichannel capability across a dense free spectrum range.

[c4] 4. The system of claim 2, wherein a said frequency locking sub-system is provided and said frequency locking sub-system and said filter devices have matching resonant frequencies.

[c5] 5. The system of claim 1, wherein said sensor modules additionally include temperature sensors to produce temperature signals and said monitoring station is able to normalize said detector signals based on said temperature signals.

[c6] 6. The system of claim 1, wherein said sensor modules additionally include intensity sensors to produce intensity signals and said monitoring station is able to normalize said detector signals based on said intensity signals.

[c7] 7. The system of claim 1, wherein said sensor modules additionally include erbium doped fiber amplifiers.

[c8] 8. The system of claim 1, wherein said fiber Bragg gratings are encompassed in a member of the set consisting

of washers and pads subject to the stresses in the structure.

[c9] 9. The system of claim 1, wherein said filter devices include Fabry-Perot interference filters, thereby having light intensity in said detector signal be representative of the stresses in the structure at the sensor modules.

[c10] 10. The system of claim 1, wherein said filter devices include fiber interferometers, thereby having heterodyne interference in said detector signal be representative of the stresses in the structure at the sensor modules.

[c11] 11. The system of claim 1, wherein said plurality of sensor modules and said plurality of filter modules form a single port configuration.

[c12] 12. The system of claim 1, wherein said plurality of sensor modules and said plurality of filter modules form a multi-ports configuration.

[c13] 13. The system of claim 1, wherein said first set of optical fiber connects said plurality of sensor modules in a parallel configuration.

[c14] 14. The system of claim 1, wherein:

said laser module produces a broadband said light beam; and

said fiber Bragg gratings have different said resonant frequencies.

[c15] 15. The system of claim 14, wherein said first set of optical fiber connects said plurality of sensor modules in a serial configuration.

[c16] 16. The system of claim 14, further comprising a demultiplexer and wherein said first set of optical fiber connects said plurality of sensor modules in a parallel configuration.

[c17] 17. The system of claim 1, wherein said monitoring station is able to perform said analysis with respect to time.

[c18] 18. The system of claim 1, wherein said monitoring station is able to compare said detector signals against a database of installation information for the structure.

[c19] 19. The system of claim 1, wherein said monitoring station is able to communicate results and warnings based on said analysis of said detector signals.

[c20] 20. A method of analyzing the stresses in a structure, the method comprising the steps of:

(a) providing a light beam to a plurality of fiber Bragg gratings installed in the structure;

(b) reflecting a first portion of said light beam from

each said fiber Bragg grating;

(c) passing said first portions through respective interference units as second portions of said light beam having filtered light characteristics;

(d) detecting said filtered light characteristics in said second portions of said light beam; and

(e) comparing said filtered light characteristics against previously collected data for said filtered light characteristics, thereby permitting analysis of changes in the stresses in the structure.

[c21] 21. The method of claim 20, further comprising locking frequencies in said light beam.

[c22] 22. The method of claim 21, wherein said frequencies in said light beam are locked to match resonant frequencies of said interference units.

[c23] 23. The method of claim 20, further comprising stabilizing intensity of said light beam.

[c24] 24. The method of claim 20, further comprising detecting temperatures at said fiber Bragg gratings and normalizing said filtered light characteristics based thereon.

[c25] 25. The method of claim 20, further comprising detecting reference light intensities in said light beam at said fiber Bragg gratings and normalizing said filtered light

characteristics based thereon.

[c26] 26. The method of claim 20, wherein said interference units include Fabry-Perot interference filters, thereby having light intensities be said filtered light characteristics.

[c27] 27. The method of claim 20, wherein said interference units include fiber interferometers, thereby having heterodyne interference be said filtered light characteristics.

[c28] 28. The method of claim 20, wherein said fiber Bragg gratings have different resonant frequencies and said step (a) includes having said light beam include a plurality of different frequencies and serially providing said light beam to said plurality of fiber Bragg gratings.

[c29] 29. The method of claim 20, wherein said step (a) includes providing said light beam to said plurality of fiber Bragg gratings in parallel.

[c30] 30. The method of claim 20, wherein said fiber Bragg gratings have different resonant frequencies and said step (a) includes having said light beam include a plurality of different frequencies, demultiplexing said light beam into portions having said different frequencies, and providing said portions to said plurality of fiber Bragg gratings in parallel.

[c31] 31. The method of claim 20, wherein said step (e) includes comparing a plurality of said filtered light characteristics collected from different said fiber Bragg gratings with respect to time.

[c32] 32. The method of claim 20, wherein said step (e) includes storing said plurality of said filtered light characteristics in a database.

[c33] 33. The method of claim 20, wherein said step (e) includes retrieving said previously collected said filtered light intensities from a database.

[c34] 34. The method of claim 20, further comprising:

(f) communicating a warning when comparison in said step (e) indicates that at least one said filtered light characteristic and its respective said previously collected said filtered light characteristic exceeds a pre-set limit.